

# ***Understanding different modes of operation in DP83869***

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## **ABSTRACT**

The DP83869HM device is a robust, fully-featured Ethernet Physical Layer (PHY) transceiver with integrated PMD sublayers that supports 10BASE-Te, 100BASE-TX and 1000BASE-T Ethernet protocols. The DP83869HM also supports 1000BASE-X and 100BASE-FX Fiber protocols. This device supports three MAC interfaces and two MDI interfaces. Supported media access control (MAC) interfaces are MII, RGMII and SGMII. 10Base-Te, 100Base-TX, 1000Base-T, 100Base-FX and 1000Base-X are supported on the media interface.

The DP83869HM can support several unique modes of operation. This application note describes all modes of operation and how to configure DP83869HM device for the desired application.

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## 1 Mode of Operation

The DP83869HM has three major electrical interfaces:

- MDI interface to copper cable (10Base-Te, 100Base-TX and 1000Base-T)
- Parallel interface (MII and RGMII)
- SERDES interface (100Base-FX, 1000BaseX and SGMII) SERDES interface (100Base-FX, 1000BaseX and SGMII)

The MDI interface to copper cable is always a media interface. The MII interface is always a MAC interface which is typically connected to an Ethernet MAC device. The RGMII interface can be either a MAC interface or a media interface. The SERDES interface can be either a MAC interface or a media interface.

The operation mode configuration from strap is recorded in register 0x01DF.

### 1.1 2.1. RGMII-to-Copper (10Base-Te/100Base-TX/1000Base-T)

When the DP83869 is used in RGMII-to-Copper mode, the RGMII interface must be connected to an Ethernet MAC which supports RGMII. The MDI must be connected to a magnetic transformer and RJ-45 connector.

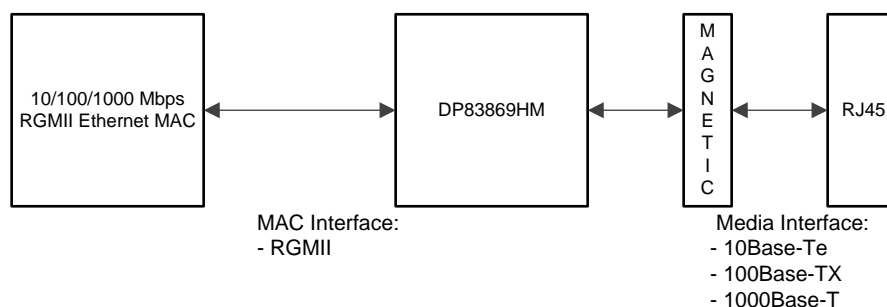


Figure 1. RGMII-to-Copper Mode

Table 1 shows the strap configuration for RGMII-to-Copper mode.

Table 1. Strap Table for RGMII-to-Copper Mode

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	OPEN
RX_D2	OPMODE_2	35	OPEN

Register 0x01DF will contain 0x0040 for RGMII-to-Copper mode.

Other straps for the copper media interface need to be configured properly for the specific application and board design. The straps for copper interface are shown in [Table 2](#).

**Table 2. Strap Table for Copper Interface**

PIN NAME	STRAP NAME	PIN #
LED_0	ANEG_DIS	47
LED_1	ANEGSEL_0	46
LED_2	ANEGSEL_1	45
RX_CTRL	MIRROR_EN	38

**Table 3. Strap Functional Table for Copper Interface**

ANEG_DIS	ANEGSEL_0	ANEGSEL_1	FUNCTION
0	0	0	Auto-negotiation, 1000/100/10 advertised, Auto MDI-X
0	0	1	Auto-negotiation, 1000/100 advertised, Auto MDI-X
0	1	0	Auto-negotiation, 100/10 advertised, Auto-MDI-X
0	1	1	N/A
1	0	0	N/A
1	0	1	N/A
1	1	0	Forced 100M, full duplex, MDI mode
1	1	1	Forced 100M, full duplex, MDI-X mode
<b>MIRROR_EN</b>			
0			Port Mirroring Disabled
1			Port Mirroring Enabled

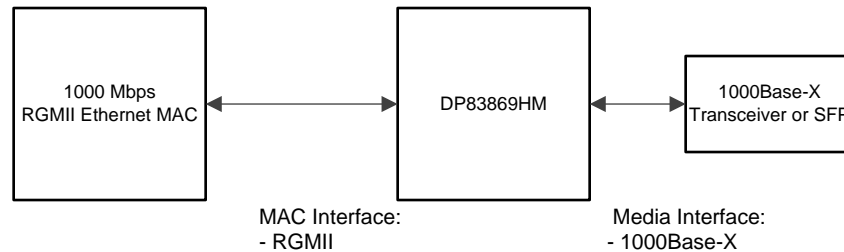
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**NOTE:** See the DP83869 data sheet ([SNLS614](#)) for designing hardware straps

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## 1.2 RGMII-to-1000Base-X

In RGMII-to-1000Base-X mode, the RGMII interface must be connected to an Ethernet MAC which supports RGMII. The SERDES is a media interface in this mode and should be connected to 1000Base-X transceiver or SFP module.



**Figure 2. RGMII-to-1000Base-X Mode**

The strap configuration for RGMII-to-1000Base-X mode is shown in [Table 4](#).

**Table 4. Strap Table for RGMII-to-1000Base-X Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	2.49KΩ Pull-up to VDDIO
RX_D3	OPMODE_1	36	OPEN
RX_D2	OPMODE_2	35	OPEN

Register 0x01DF will contain 0x0041 for RGMII-to-1000Base-X mode.

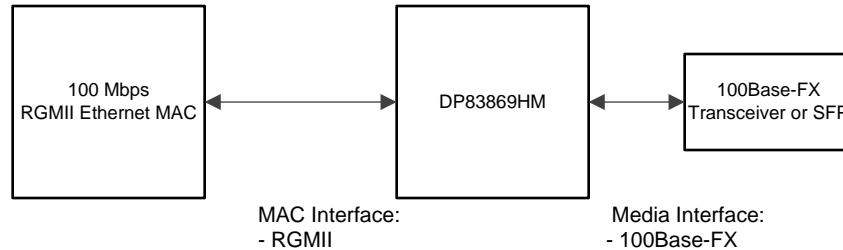
Other straps for 1000Base-X media interface need to be configured properly for the specific application and board design.

**Table 5. Strap Table for 1000Base-X Interface**

PIN NAME	STRAP NAME	PIN #		FUNCTION
LED_0	ANEG_DIS	47	0	Fiber Auto-negotiation ON
			1	Fiber Force mode
LED_1	ANEGSEL_0	46	0	Signal Detect disable on Pin 24
			1	Configure Pin 24 as Signal Detect Pin

### 1.3 RGMII-to-100Base-FX

In RGMII-to-100Base-FX mode, the RGMII interface must be connected to an Ethernet MAC which supports RGMII. SERDES is a media interface in this mode and should be connected to 100Base-FX transceiver or SFP module.



**Figure 3. RGMII-to-100Base-FX Mode**

The strap configuration for RGMII-to-100Base-FX mode is shown in [Table 6](#).

**Table 6. Strap Table for RGMII-to-100Base-FX Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	2.49KΩ Pull-up to VDDIO
RX_D2	OPMODE_2	35	OPEN

Register 0x01DF will contain 0x0042 for RGMII-to-100Base-FX mode.

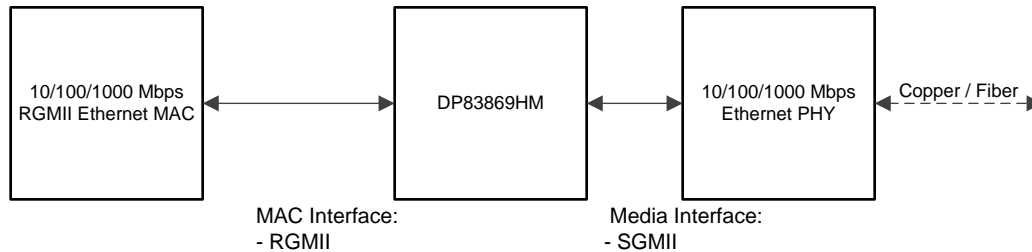
Other straps for 100Base-FX media interface need to be configured properly for the specific application and board design.

**Table 7. Strap Table for 100Base-FX Interface**

PIN NAME	STRAP NAME	PIN #		FUNCTION
LED_1	ANEGSEL_0	46	0	Signal Detect disable on Pin 24
			1	Configure Pin 24 as Signal Detect Pin

## 1.4 RGMII-to-SGMII Bridge

In RGMII-to-SGMII Bridge mode, the RGMII interface must be connected to an Ethernet MAC which supports RGMII. The SERDES interface is operating as a SGMII MAC device in this mode. This SGMII interface can be connected to another SGMII PHY device that supports either copper or fiber media interface.



**Figure 4. RGMII-to-SGMII Bridge Mode**

The strap configuration for RGMII-to-SGMII Bridge mode is shown in [Table 8](#).

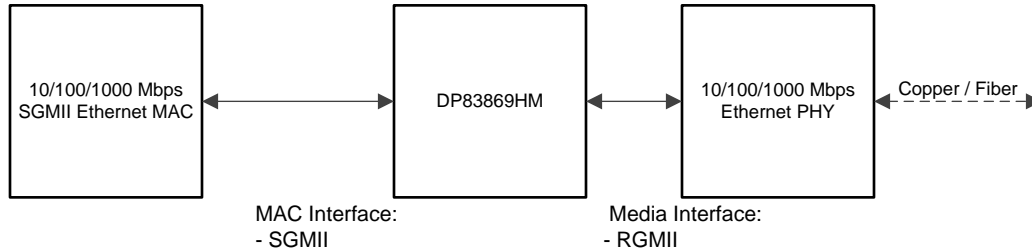
**Table 8. Strap Table for RGMII-to-SGMII Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	2.49K $\Omega$ Pull-up to VDDIO
RX_D3	OPMODE_1	36	2.49K $\Omega$ Pull-up to VDDIO
RX_D2	OPMODE_2	35	OPEN
RX_CTRL	MIRROR_EN	38	OPEN

Register 0x01DF will contain 0x0003 for RGMII-to-SGMII Bridge mode.

## 1.5 SGMII-to-RGMII Bridge

In SGMII-to-RGMII Bridge mode, the SGMII interface must be connected to an Ethernet MAC which supports SGMII. The RGMII interface is operating as a RGMII MAC device in this mode. This RGMII interface can be connected to another RGMII PHY device that supports either copper or fiber media interface.



**Figure 5. SGMII-to-RGMII Bridge Mode**

The strap configuration for RGMII-to-SGMII Bridge mode is shown in [Table 9](#).

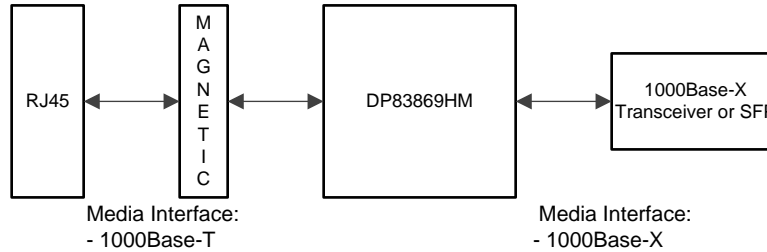
**Table 9. Strap Table for SGMII-to-RGMII Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	2.49K $\Omega$ Pull-up to VDDIO
RX_D3	OPMODE_1	36	2.49K $\Omega$ Pull-up to VDDIO
RX_D2	OPMODE_2	35	OPEN
RX_CTRL	MIRROR_EN	38	2.49K $\Omega$ Pull-up to VDDIO

Register 0x01DF will contain 0x0043 for RGMII-to-SGMII Bridge mode.

## 1.6 1000 Mbps Media Converter

In 1000 Mbps Media Converter mode, the DP83869HM translates data between copper and fiber interfaces at 1000 Mbps rate. The SERDES is a media interface in this mode and should be connected to 1000Base-X transceiver or SFP module. The MDI should be connected to transformer magnetics and RJ-45 connector.



**Figure 6. 1000 Mbps Media Converter Mode**

The strap configuration for 1000 Mbps Media Converter mode is shown in [Table 10](#).

**Table 10. Strap Table for 1000 Mbps Media Converter Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	OPEN
RX_D2	OPMODE_2	35	2.49KΩ Pull-up to VDDIO

Register 0x01DF will contain 0x0044 for 1000 Mbps Media Converter mode.

**NOTE:** Important: Required register configuration for 1000 Mbps Media Converter mode: - **Write 0x1FFC to register 0x01EC (set bit [0] to 0)**

Other straps for Copper media interface and 1000Base-X interface need to be configured properly for the specific application and board design.

**Table 11. Strap Table for Copper and 1000Base-X Interface**

PIN NAME	STRAP NAME	PIN #	FUNCTION	
			<b>ANEG_DIS</b>	
LED_0	ANEG_DIS	47	0	Fiber Auto-negotiation ON
			1	Fiber Force mode
			<b>ANEGSEL_0</b>	<b>ANEGSEL_1</b>
LED_1	ANEGSEL_0	46	1	1
LED_2	ANEGSEL_1	45		
				Copper Auto Negotiation (1000 Advertised), Auto MDIX



### 1.7 100 Mbps Media Converter

In 100 Mbps Media Converter mode, the DP83869HM translates data between copper and fiber interface at 100 Mbps rate. The SERDES is a media interface in this mode and should be connected to 100Base-X transceiver or SFP module. The MDI should be connected to a magnetic and RJ-45 connector.

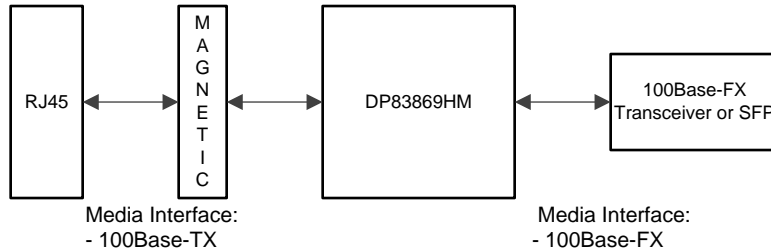


Figure 7. 100 Mbps Media Converter Mode

The strap configuration for 100 Mbps Media Converter mode is shown in Table 12.

Table 12. Strap Table for 100 Mbps Media Converter Mode

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	2.49KΩ Pull-up to VDDIO
RX_D3	OPMODE_1	36	OPEN
RX_D2	OPMODE_2	35	2.49KΩ Pull-up to VDDIO

Register 0x01DF will contain 0x0045 for 100 Mbps Media Converter mode.

**NOTE:** Important: Required register configuration for 100 Mbps Media Converter mode: - Write 0x1FFC to register 0x01EC (set bit [0] to 0)

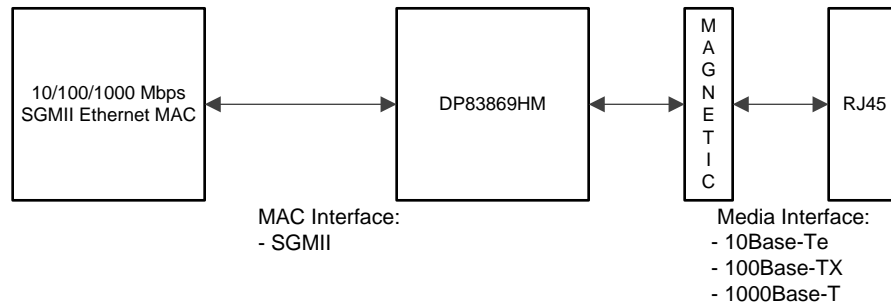
Other straps for the Copper media interface and 100Base-FX interface need to be configured properly for the specific application and board design.

Table 13. Strap Table for Copper and 100Base-FX Interface

PIN NAME	STRAP NAME	PIN #	FUNCTION		
			ANEGSEL_0	ANEGSEL_1	
LED_1	ANEGSEL_0	46	1	1	Copper Auto Negotiation (100 Advertised), Auto MDIX
LED_2	ANEGSEL_1	45			
			MIRROR_EN		
RX_CTRL	MIRROR_EN	38	0		Copper Mirror Disable
			1		Copper Mirror Enable
			LINK_LOSS		
RX_CLK	LINK_LOSS	32	0		Link Loss Pass Thru Enabled
			1		Link Loss Pass Thru Disabled

### 1.8 SGMII-to-Copper (10Base-Te/100Base-TX/1000Base-T)

In SGMII-to-Copper mode, the SGMII interface should be connected to an Ethernet MAC which supports the SGMII protocol. The MDI should be connected to transformer magnetics and RJ-45 connector.



**Figure 8. SGMII-to-Copper Mode**

The strap configuration for SGMII-to-Copper mode is shown in [Table 14](#).

**Table 14. Strap Table for SGMII-to-Copper Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	2.49KΩ Pull-up to VDDIO
RX_D2	OPMODE_2	35	2.49KΩ Pull-up to VDDIO

Register 0x01DF will contain 0x0046 for SGMII-to-Copper mode.

Other straps for the copper media interface need to be configured properly for the specific application and board design. The straps for Copper interface are shown in [Table 15](#) and [Table 16](#).

**Table 15. Strap Table for Copper Interface**

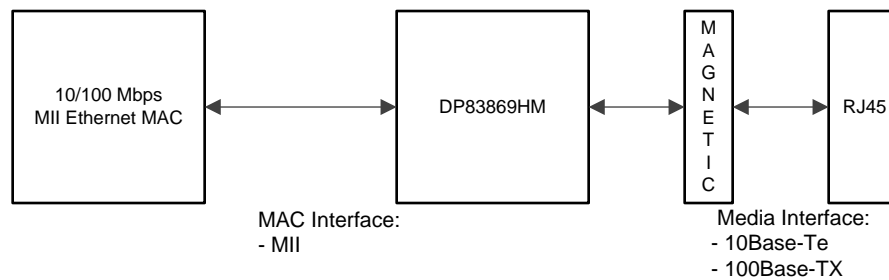
PIN NAME	STRAP NAME	PIN #
LED_0	ANEG_DIS	47
LED_1	ANEGSEL_0	46
LED_2	ANEGSEL_1	45
RX_CTRL	MIRROR_EN	38

**Table 16. Strap Functional Table for Copper Interface**

ANEG_DIS	ANEGSEL_0	ANEGSEL_1	FUNCTION
0	0	0	Auto-negotiation, 1000/100/10 advertised, Auto MDI-X
0	0	1	Auto-negotiation, 1000/100 advertised, Auto MDI-X
0	1	0	Auto-negotiation, 100/10 advertised, Auto-MDI-X
0	1	1	N/A
1	0	0	N/A
1	0	1	N/A
1	1	0	Forced 100M, full duplex, MDI mode
1	1	1	Forced 100M, full duplex, MDI-X mode
<b>MIRROR_EN</b>			
0			Port Mirroring Disabled
1			Port Mirroring Enabled

## 1.9 MII-to-Copper (10Base-T<sub>e</sub>/100Base-TX)

In MII-to-Copper mode, the MII interface should be connected to an Ethernet MAC which supports MII. The MDI should be connected to transformer magnetics and RJ-45 connector.



**Figure 9. MII-to-Copper Mode**

The strap configuration for MII-to-Copper mode is shown in [Table 17](#).

**Table 17. Strap Table for MII-to-Copper Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	OPEN
RX_D2	OPMODE_2	35	OPEN

**NOTE:** Important: Required register configuration for MII-to-Copper mode: - Write 0x0060 to register 0x01DF

Register 0x01DF will contain 0x0060 for MII-to-Copper mode.

Other straps for the copper media interface need to be configured properly for the specific application and board design. The straps for Copper interface are shown in [Table 18](#) and [Table 19](#).

**Table 18. Strap Table for Copper Interface**

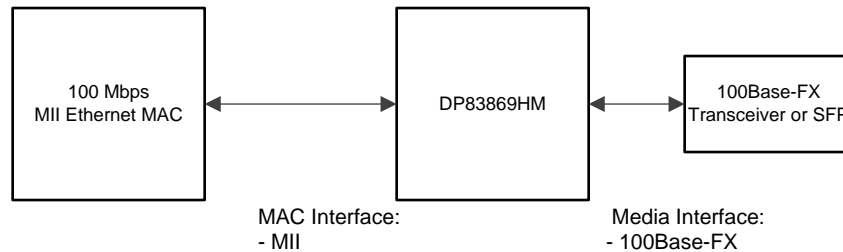
PIN NAME	STRAP NAME	PIN #
LED_0	ANEG_DIS	47
LED_1	ANEGSEL_0	46
LED_2	ANEGSEL_1	45
RX_CTRL	MIRROR_EN	38

**Table 19. Strap Functional Table for Copper Interface**

ANEG_DIS	ANEGSEL_0	ANEGSEL_1	FUNCTION
0	0	0	Auto-negotiation, 1000/100/10 advertised, Auto MDI-X
0	0	1	Auto-negotiation, 1000/100 advertised, Auto MDI-X
0	1	0	Auto-negotiation, 100/10 advertised, Auto-MDI-X
0	1	1	N/A
1	0	0	N/A
1	0	1	N/A
1	1	0	Forced 100M, full duplex, MDI mode
1	1	1	Forced 100M, full duplex, MDI-X mode
<b>MIRROR_EN</b>			
0			Port Mirroring Disabled
1			Port Mirroring Enabled

### 1.10 MII-to-100Base-FX

In MII-to-100Base-FX mode, the MII interface should be connected to an Ethernet MAC which supports MII. The SERDES is a media interface in this mode and should be connected to 100Base-FX transceiver or SFP module.



**Figure 10. MII-to-100Base-FX Mode**

The strap configuration for MII-to-100Base-FX mode is shown in [Table 20](#).

**Table 20. Strap Table for MII-to-100Base-FX Mode**

PIN NAME	STRAP NAME	PIN #	PIN STRAP CONNECTION
JTAG_TDO / GPIO_1	OPMODE_0	22	OPEN
RX_D3	OPMODE_1	36	2.49KΩ Pull-up to VDDIO
RX_D2	OPMODE_2	35	OPEN

**NOTE:** Important: Required register configuration for MII-to-100Base-FX mode: - **Write 0x0062 to register 0x01DF**

Register 0x01DF will contain 0x0062 for MII-to-100Base-FX mode.

Other straps for 100Base-FX media interface need to be configured properly for the specific application and board design.

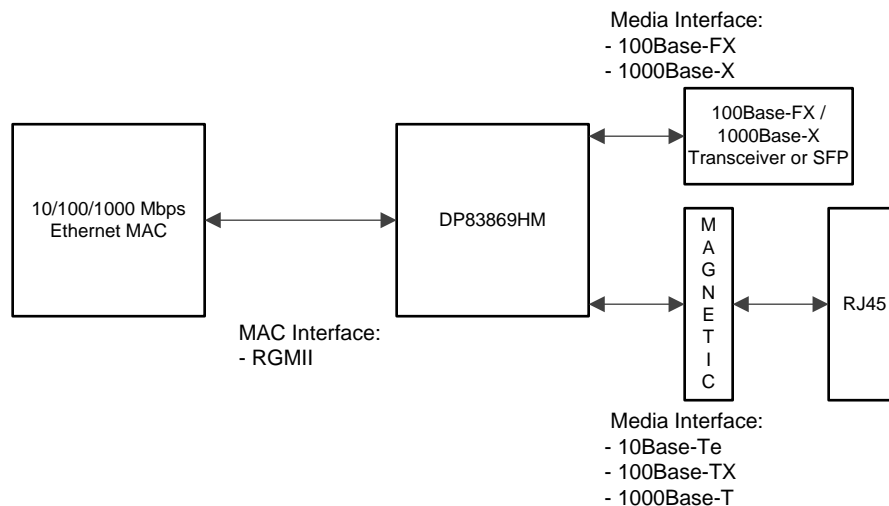
**Table 21. Strap Table for 100Base-FX Interface**

PIN NAME	STRAP NAME	PIN #	FUNCTION	
LED_1	ANEGSEL_0	46	0	Signal Detect disable on Pin 24
			1	Configure Pin 24 as Signal Detect Pin

### 1.11 RGMII-to-Fiber/Copper (Special Use-Case)

In application that requires both copper media (10Base-Te/100Base-TX/1000Base-T) and fiber media (100Base-FX/1000BaseX), RGMII interface must be used. Software configuration is required to switch between RGMII-to-Copper and RGMII-to-Fiber mode. The copper and fiber media detection mechanism and system implementation are beyond the scope of this application note.

In this special mode, the RGMII interface should be connected to an Ethernet MAC which supports RGMII. The MDI should be connected to transformer magnetics and RJ-45 connector. The SERDES is a media interface and should be connected to 100Base-FX transceiver or 1000Base-X transceiver or SFP module.



**Figure 11. RGMII-to-Fiber/Copper Mode**

#### 1.11.1 Start-up Strap in RGMII-to-Copper mode:

Required register configuration when switching to RGMII-to-1000Base-X mode using software:

- Write 0x0041 to register 0x01DF
- Write 0x1140 to register 0x0C00
- Write 0x4000 to register 0x001F

Required register configuration when switching to RGMII-to-100Base-FX mode using software:

- Write 0x0042 to register 0x01DF
- Write 0x2100 to register 0x0C00
- Write 0x4000 to register 0x001F

#### 1.11.2 Start-up Strap in RGMII-to-Fiber mode:

Required register configuration when switching to RGMII-to-Copper mode using software:

- Write 0x0040 to register 0x01DF
- Write 0x1140 to register 0x0000
- Write 0x01E1 to register 0x0004
- Write 0x0300 to register 0x0009
- Write 0x5048 to register 0x0010
- Write 0x4000 to register 0x001F

## 2 Conclusion

This application note explains different Modes of Operation and how to configure the DP83869HM device. The strap configuration and register setting recommendations for each mode will help to ease board design for target application and minimal system bring up effort.

## 3 References

[DP83869HM High immunity 10/100/1000 ethernet physical layer transceiver with copper and fiber interface](#) datasheet SNLS614.

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